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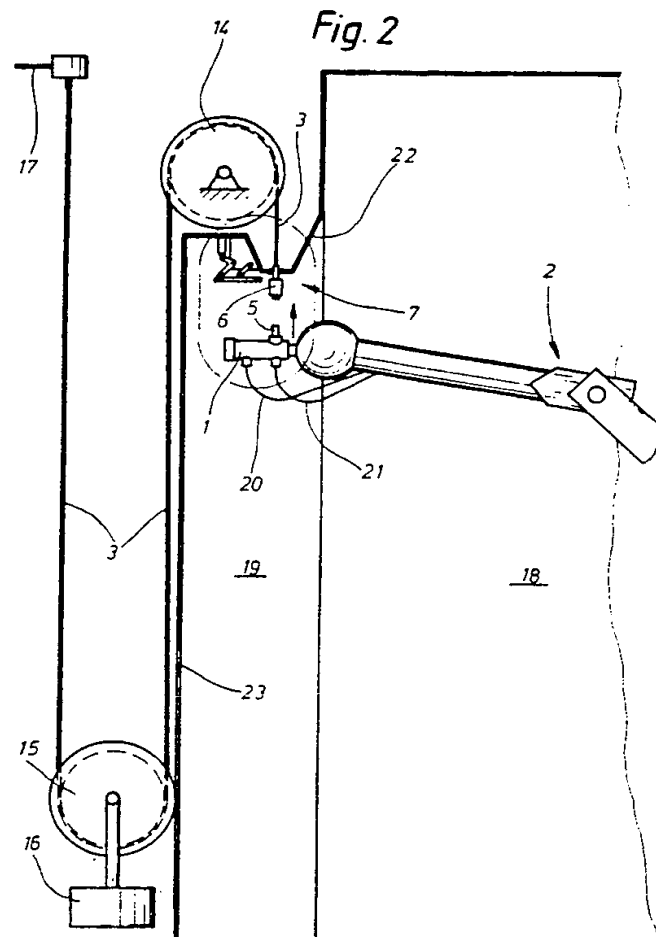
None

(58) Field of search

B2L

## (54) Apparatus for painting parts with different colours

(57) Apparatus for painting parts with different colours, comprises separate paint lines 3, which can be fitted together with the mechanically directed spray element 1 by means of quick-change plug couplings 5, 6, provided for each colour. The quick-change plug coupling 5, 6 is directly mounted on the spray element 1 itself, so that the amount of paint to be discarded in the colour change is merely restricted to the cavities of the spray element which have admitted paint. The area behind the quick-change plug coupling 5/6 is designed as a flexible tube which is automatically extractable from the coupling holder 7 and automatically retractable due to a returning force of weighted pulley 15.



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Fig. 1

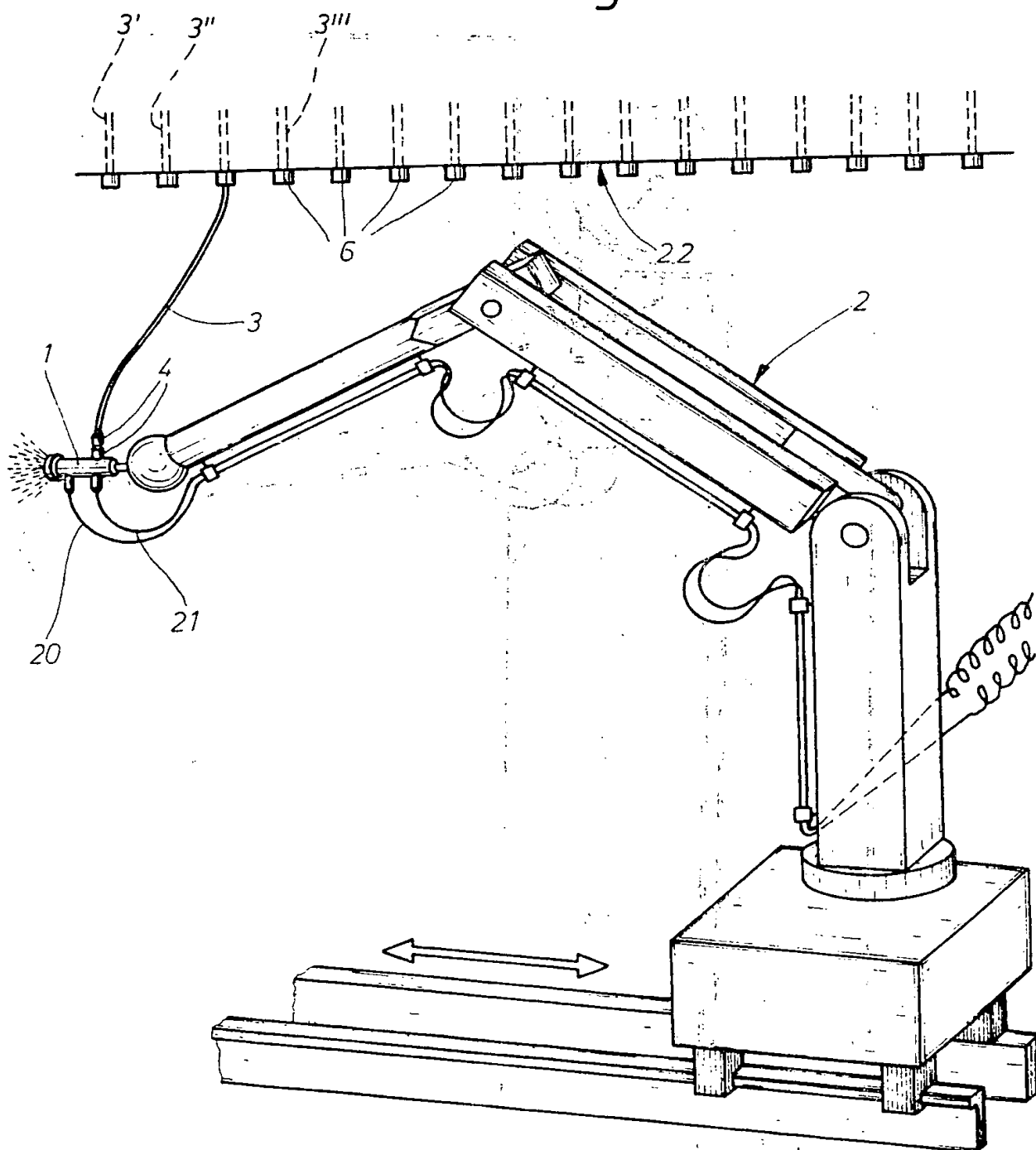
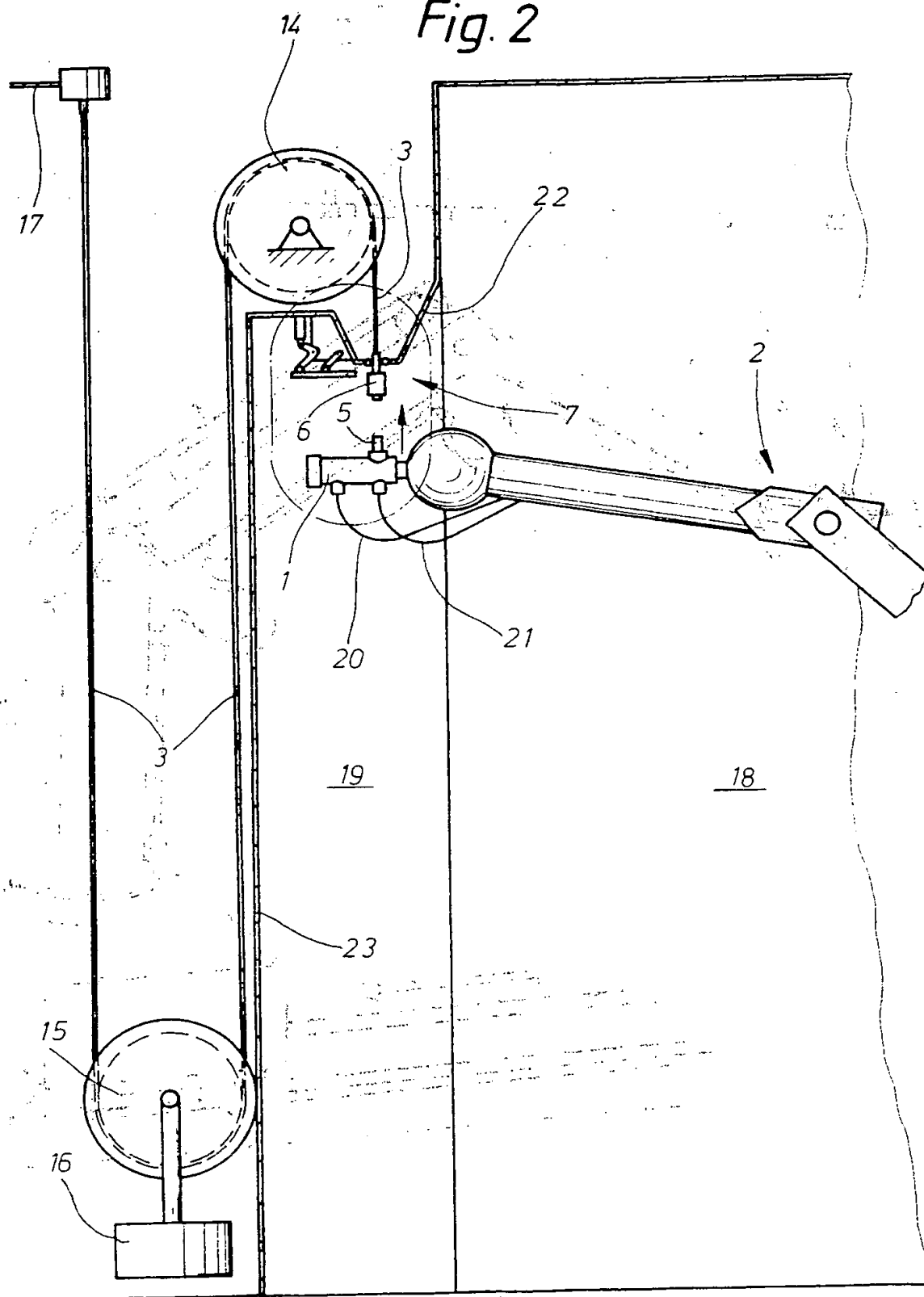


Fig. 2





## SPECIFICATION

**Apparatus for the painting of standard parts with different colours**

The invention relates to apparatus for painting parts with different colours the apparatus having a spray element adapted to be selectively coupled to a selected one of a plurality of paint lines through which the different colour paints are supplied. Such apparatus is disclosed, for example, in U.S. Patent Specification 3,674,207.

When painting standard parts with different colours the spray element must be connected to the paint line corresponding to the particular colour desired. In most cases, so-called colour-change valve blocks, in which the colour change can be effected by means of appropriate valves, are provided for this purpose. Reference may be made in this connection, for example, to US Patent Specification 3,373,762, US Patent Specification 3,145,930 or German Patent Specification 2,064,238. As a departure from this generally customary colour change technique by means of changeover valves, the publication cited at the start (U.S. Patent Specification No. 3,674,207) discloses a device for colour change in which various lines are connected to one another by means of plug couplings. In every case, however, the part in which a fluid connection to the various paint lines is made is relatively far removed spatially from the actual spray element; that is, the colour-change device is connected to the spray element via a common line for all colours. This common line for all colours has to be cleaned for every colour change and the old paint contained in it discarded. Since colour changes occur relatively frequently in mass production of standard parts with different colours, and since this common line for all colours is relatively long—it corresponds to the range of movement of the movable spray element—not only is the total amount of colour discarded during colour changes relatively large but this also creates an equivalent pollution problem, since the investment and operating cost expenditure for the environmentally acceptable purification of the painting waste water and painting booth exhaust air is very great.

The object of the invention is to design the basic apparatus for colour change in such a way that not only the amount of paint to be discarded in the colour change is very low but also that the pollution control-related consequential costs of such discarding are minimised.

According to the invention there is provided apparatus for painting parts with different colours, the apparatus having a spray element adapted to be selectively coupled to a selected one of a plurality of paint lines through which

the different paints are supplied through a quick-change plug coupling comprising a self-closing coupling on each paint line engageable with a corresponding coupling counterpart on the spray element, to form a fluid connection between the selected paint line and the spray element, the counterpart being mechanically insertable in opposition to the self-closing coupling of the selected paint line, wherein the couplings of the paint lines are each detachably held in a position in a coupling holder which can be reached by the spray element, the counterpart being directly mounted on the spray element itself, and each paint line contains behind the self-closing coupling a flexible piece accommodating at least the range of movement of the spray element, which flexible piece is automatically extractable from the coupling holder and is automatically retractable into the coupling holder by a returning force acting on said flexible piece.

On this basis, the colour change takes place spatially directly at the spray element itself through a quick-change plug technique. The amount of paint to be discarded in a colour change is thus restricted merely to the cavities in the spray element itself which receive paint, which is only a tiny fraction of the amount which had to be discarded in the known systems. As a rule, the spray element is designed with such a smooth surface and so regularly, that the old paint can be displaced by the new paint without requiring a rinsing operation with a special detergent. A separate intermediate rinsing operation with a detergent need normally only be made if there are paint-admitting spaces of a very complicated design within the spray element, as is the case for example in spray elements for two-component colours. However, even in this case the amount of paint to be discarded is reduced to an essential minimum. Since the paint generally occurs in concentration and the time for spraying out the old paint is also only very short, the pollution nuisance caused by the colour change is only very small. The paint to be discarded can be caught directly in a collecting vessel, so that no painting waste water is thereby polluted. Due to the short time required for spraying out the old paint, the contamination of painting booth air with paint mist and vapours is also only very low, so that the painting booth exhaust air is contaminated to a hardly perceptible extent by the colour change.

A preferred embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a painting robot with coupling of a flexible paint line selected from a plurality of various paint lines directly at the spray element itself,

Figure 2 shows the plugging-on operation of a new paint line to the spray element and

Figure 3 shows the enlarged representation of the detail in Figure 2 indicated by III.

The figures show an industrial robot 2, which bears a spray element 1 at the end of its working arm. The industrial robot is movably installed in a painting booth in the form of a spray cabin 18. In aniche 19 of the spray cabin, a holding bracket 22 for holding a plurality of flexible paint lines 3, 3' 3'', 3''' etc. is provided at the top. Each of the paint lines can be fitted selectively together with the spray element 1 by means of a quick-change plug coupling comprising a coupling segment 5 on the spray element and a cooperating coupling segment 6 on each of the paint lines 3, 3' etc. the paint lines not required in each case being urged back into the corresponding coupling holder 7 on the holding bracket 22 and the paint line just connected being extracted from the corresponding coupling holder 7. The coupling segment 5 on the spray element side is directly mounted on the spray element 1 itself, so that the change device is spatially located as near as possible to the point of paint atomisation and the amount of paint to be discarded in the colour change is as small as possible.

For the colour change, the spray element is moved by the industrial robot up to the holding bracket 22 above the niche 19, the old paint line initially being pushed back into the coupling holder 7. The quick-change plug coupling can be released by means of a disengaging mechanism to be discussed later. The spray element 1 is then moved into the position of the paint line of the new colour so that the coupling segment 5 of the spray element and the coupling segment 6 of the selected paint line are axially opposite each other in exact axial alignment. This state is shown in Figures 2 and 3.

By moving the two coupling segments 5 and 6 completely into engagement, the quick-change plug coupling is made automatically, so that the flexible tube line can be extracted from the coupling holder. Before commencing painting with the new colour, first a collecting vessel for the old paint is approached and the old paint contained in the spray element is discharged by the new paint. In the case of particularly high requirements on the completeness of colour discharge and/or in the case of highly angular paint-conducting spaces inside the spray element, it is appropriate to rinse the spray element with detergent. For this purpose, a detergent line 21 up to the spray element must also be laid—as shown—along the movable robot arm in addition to the atomiser air line 20. After cleaning the spray element of old paint, painting with the new colour can commence.

In order to enable the selected flexible paint line to be extracted from the coupling holder 7 on the holding bracket 22 and to make it possible to push the line back, the holding

bracket 22 receiving the coupling holders is of hollow design and guide rollers 8 are arranged in the edge region at the borders of the gap through which the paint lines pass.

The guide rollers describe a rectangular hole in which a corresponding rectangular pin 9 of the coupling segment 6 can be received stably. Moreover, also provided on the coupling segment 6 is a contact shoulder 10, which also ensures a defined position in axial and angular senses. The latter is important to allow the desired new paint line to be securely fitted on mechanically in the colour change.

In order to deposit the no longer required paint line on the appropriate coupling holder, the quick-change plug coupling has to be disengaged. For this purpose, in the embodiment shown, the coupling segment 6 on the paint lines is provided in each case with a

disengaging sleeve 11. Furthermore, a disengaging mechanism in the form of a disengaging fork 12, which is movable to and fro and can be displaced by means of an actuating cylinder 13, is arranged in the area of each coupling holder.

Specifically, the disengaging fork 12 is normally located in the retracted position shown in Figures 2 and 3, in which position the fork does not hinder the mobility of the paint line during painting or during the to-and-fro movement of the line. The actuating cylinder 13, and with it the disengaging fork 12, is merely extended during the final part of pushing back the off-line into the coupling holder in such a way that the fork engages behind the disengaging sleeve 11.

When the quick-change plug coupling is pushed back even further into the coupling holder 7 the coupling sleeve 11 is displaced axially in the disengaging sense by the disengaging fork, so that the quick-change plug coupling releases the coupling segment 5 on the spray element, so that the latter can be extracted from the quick-change plug coupling. Inside the coupling segment 6 on the paint line is located an automatically closing non-return valve, which prevents paint escaping from the paint line. Instead of arranging the disengaging sleeve 11 in each case on the coupling segment 6 of the paint lines, it is also conceivable to attach the disengaging sleeve 11 on the opposite coupling segment 5 on the spray element and linking this sleeve with a corresponding actuating cylinder. However, this would require laying a further control line on the movable robot arm, but in turn, the plurality disengaging mechanisms 12, 13 in the area of the coupling holders could be dispensed with.

In order to maintain a certain tension on the paint line during painting—it must not hang down too low garland-like and touch the workpiece—and in order to ensure a quick return of the paint line to the coupling holder when depositing the old paint line, each flexible paint line is provided with a corresponding

returning force, namely a pulley 14 is provided in each case above each and every coupling holder 7 for every flexible paint line, which pulley guides the paint line into a vertically downward running strand which runs along the cabin wall 23 and round a floating tension pulley 15, which has an associated tensioning weight 16. After U-shaped contact around the tension pulley 15, the paint tube runs vertically upwards to a stationary paint connection, from which a fixed paint line 17 runs to a supply tank and a paint delivery element.

Instead of using a "straight" run for paint lines laid in movable loops it would also be conceivable to use helically wound tube lines hanging down from the ceiling of the spray cabin. However, in this case a different type of coupling holder would have to be provided for the coupling segment 6 on the paint line; practically the only conceivable design would be a holder in a fork open on one side, into which fork the coupling segment is radially pushed in or extracted. It would also be expedient if the individual helically wound paint tubes could each be moved individually from the series of paint lines during painting in order to avoid collisions with one another, so that the particular paint line needed at the time is located spatially separate from the series of other paint lines.

It would also be conceivable to programme the sequence of movements of the industrial robot in the colour change in such a way that the robot automatically lays the paint line needed in each case along the course of the movable robot arm in corresponding closing holding forks or the like. This admittedly somewhat more elaborate type of colour change would however make it possible also to paint in enclosed spaced in the bodywork, such as for example in the passenger compartment of vehicle bodies, which is only accessible through the doors or through the window openings. Paint lines running up freely would only impede such work.

Although described as having different colours it will be understood that the lines may also provide different types of paint e.g. primer, undercoat or top coat. Furthermore, one type or colour of paint may be provided from more than one paint line. This arrangement would be advantageous where for example, the paints are supplied in standard sized containers and one type or colour of paint is used in much greater quantities in each painting cycle.

#### CLAIMS

1. Apparatus for painting parts with different colours, the apparatus having a spray element adapted to be selectively coupled to a selected one of a plurality of paint lines through which the different paints are supplied through a quick-change plug coupling

comprising a self-closing coupling on each paint line engageable with a corresponding coupling counterpart on the spray element, to form a fluid connection between the selected paint line and the spray element, the counterpart being mechanically insertable in opposition to the self-closing coupling of the selected paint line, wherein the couplings of the paint lines are each detachably held in a position in a coupling holder which can be reached by the spray element the counterpart being directly mounted on the spray element itself, and each paint line contains behind the self-closing coupling a flexible piece accommodating at least the range of movement of the spray element, which flexible piece is automatically extractable from the coupling holder and is automatically retractable into the coupling holder by a returning force acting on said flexible piece.

2. Apparatus according to claim 1, wherein the spray element is adapted to be mechanically directed relative to the workpiece surface.

3. Apparatus according to claim 1 or 2, wherein the flexible piece of each paint line passes round at least two pulleys, the first having its axis of rotation fixed relative to the holder, the second pulley comprising a floating pulley lying in a U-shaped part of said flexible piece and having attached thereto a weight from which said returning force is derived.

4. Apparatus for the painting of standard parts with different colours; substantially as described herein with reference to and as illustrated in the accompanying drawings.

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